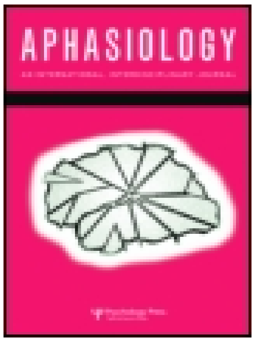
The common denominator in the perception of accents in cases with foreign accent syndrome

Jonkers, Roel; van der Scheer, Fennetta; Gilbers, Dicky

Published in:
Aphasiology

DOI:
10.1080/02687038.2016.1232362



Routledge
Taylor & Francis Group

Aphasiology

ISSN: 0268-7038 (Print) 1464-5041 (Online) Journal homepage: http://www.tandfonline.com/loi/paph20

The common denominator in the perception of accents in cases with foreign accent syndrome

Roel Jonkers, Fennetta van der Scheer & Dicky Gilbers

APHASIOLOGY, 2016
http://dx.doi.org/10.1080/02687038.2016.1232362

The common denominator in the perception of accents in cases with foreign accent syndrome

Roel Jonkers[a], Fennetta van der Scheer[b] and Dicky Gilbers[a]

[a]Center for Language and Cognition Groningen (CLCG), University Groningen, Groningen, The Netherlands; [b]Advies- en behandelcentrum Zorggroep Noordwest Veluwe, Harderwijk, The Netherlands

ABSTRACT

Background: Foreign accent syndrome (FAS) is a rare speech disorder leading to a perceived presence of a new accent in a speaker's speech. Until now, around 100 cases of FAS have been reported. It is striking that in most cases the perception of the accent is in one consistent direction, namely from languages like English or Dutch to accents of Romance, Germanic, Eastern European or tonal languages.

Aims: In this article, we will try to come up with an overarching explanation for the accent changes seen in FAS, relating these changes to force of articulation.

Main Contribution: We assume that the foreign accent in FAS is interpreted on the basis of the stereotypical segmental and prosodic characteristics that relate to the phonetics and phonology of specific languages. We hypothesise that the direction in perception of a FAS accent will go from a language characterised by relatively more lenition processes, into languages with relatively more fortition characteristics in their phonetic realisations and phonological system and not the other way around. Accents are expected to change from stress-timed to syllable-timed languages, from weight-sensitive stress systems to weight-insensitive systems, from non-aspirated to aspirated systems, and within these language groups from languages characterised by, for example, relatively more reduction and assimilation processes to languages with relatively less lenition. We have tested our hypothesis with the already described FAS cases. We restricted ourselves to the cases of neurogenic FAS described in English and to which enough details were provided in order to be able to judge the change of accent.

Conclusions: From the 58 cases that fitted with these criteria, almost 90% showed a change of accent in the expected direction or did not contradict our hypothesis. Only six accent changes did not directly support it. The reported phonetic descriptions of the cases, if available, nevertheless suggest that they do not seem to completely violate our hypothesis.

ARTICLE HISTORY
Received 4 April 2016
Accepted 31 August 2016

KEYWORDS
Foreign accent syndrome; force of articulation

CONTACT Roel Jonkers r.jonkers@rug.nl

Introduction

Five years ago, British pop artist George Michael ended up in an Austrian hospital with a coma after a severe lung infection. When waking up from this coma, he thought himself to be king of the world and people around him recognised that he no longer spoke with his north-London accent but with a Western English tongue. This foreign accent lasted for 2 days. Anecdotal information like this can be found all over the Internet, but fortunately, as a result of such cases, the foreign accent syndrome receives more serious scientific attention as well (see also Ryalls & Miller, 2015). There are now about 100 unique cases described in academic literature. In this article, we will try to provide an overview of these cases. What is especially striking is the perception of the accent is in the same direction in most cases, namely from languages like English or Dutch to accents of Romance, Germanic, Eastern-European or tonal languages. In this article, we will try to propose an explanation for this accent change, elaborating on our past paper published in 2014, where we described the accent change in a single speaker with FAS and related this accent change to force of articulation (van der Scheer, Jonkers, & Gilbers, 2014).

The direction of perception

In van der Scheer et al. (2014), we presented a case study of a speaker with FAS. FAS is a rare speech disorder leading to a perceived presence of a new accent in the speech of the speaker. We hypothesised that the increased force of articulation in their speech can account for the foreign accents in patients suffering from impaired speech after brain damage. In our previous paper, we related the increase of articulation in FAS speakers to their underlying impairment. Similar to various other authors, we see FAS as a compensation strategy or adaptation in relation to an underlying (mild) form of apraxia of speech (AoS) (Fridriksson et al., 2005; Kanjee, Watter, Sévigny, & Humphreys, 2010; Mariën & Verhoeven, 2007; Miller, Lowit, & O'Sullivan, 2006; Moen, 2000; Roy, Macoir, Martel-Sauvageau, & Boudreault, 2012; Whiteside & Varley, 1998). Despite the fact that many authors are linking AoS with FAS, there are also cases described in which the underlying disorder seems to be dysarthria (Mariën et al., 2013) or where it is explicitly mentioned that no motor disorders were evident. However, Miller et al. (2006), who also describe a case of FAS with an expected AoS as underlying disorder, already stated that FAS can arise from a variety of lesion sites. FAS may stem from different motor speech disorders, and it can be argued that FAS actually does not really exist in speakers, but that listeners only perceive it, or as Miller et al. conclude that FAS is a by-product of listeners' perception. Earlier, we mentioned that FAS in AoS might be seen as an adaptation to the underlying disorder, but as Miller et al. point out, this might also be the case for other motor disorders, like the scanned speech seen in speakers with ataxic dysarthria who try to circumvent their speech problems.

The question remains why not every speaker with a motor speech disorder is heard as a FAS speaker. Again, Miller et al. (2006) provide an explanation. As was also seen in the case of AA, we described in 2014 (van der Scheer et al., 2014), different features may contribute to the perception of a foreign accent, although their salience to the listeners may differ. Naive listeners focus on different aspects of speech to form their judgements.

These are influenced by the listeners' age, gender, experience with and attitudes to speech disorders or familiarity of the listener with different languages. They might even ignore aspects that do not fit their interpretation. Miller et al. (2006) state that in AOS the striking features will not be interpreted as belonging to a foreign accent, but as belonging to a disorder. Of course, this might be strengthened by the fact that AOS speakers make many speech errors and their speech is non-fluent. Only if the speech errors diminish might the remaining accent be understood as foreign, as, for example, in our case AA, who suffered from aphasia. Only after his aphasia resolved, people around him recognised the foreign accent.

Especially, those speakers with AoS, who adapt to this underlying disorder, will use strategies like segmentation and scanned speech (Feiken & Jonkers, 2012; Jonkers, Terband, & Maassen, 2014). This adaptation is done in the planning phase of speech. It is time-consuming and therefore speech is slower, which leads to less coarticulation, assimilation, reduction and an increased force of articulation; therefore, we hypothesise accent changes occur into languages that express more force of articulation.

Force of articulation, defined from an articulatory point of view, is the degree of muscular effort and breath force involved in speech production. It manifests itself in different acoustic parameters indicating the strength of the speech signal: very robust characteristics of the acoustic speech signal, such as mean pitch (fundamental frequency), pitch range, speech rate and mean intensity ("primary parameters"), but also more subtle parameters like occlusion time and voice-onset time in plosives or the first and second formant in the realisation of laterals ("secondary parameters"). Gilbers, Jonkers, Scheer van der, and Feiken (2013) describe a comprehensive model of the acoustic parameters of force of articulation and their individual strength in the perception and production of speech, the force of articulation model (FoAM), and hypothesise that force of articulation is an overarching factor in how speech is perceived aside from its semantic content, helping people distinguish between different accents.

The acoustic signal connects speech production and speech perception in the sense that differences in how speech is produced with respect to force of articulation can directly affect how speech is perceived. It is remarkable that listeners hear different foreign accents in the speech of one single FAS speaker, suggesting that the determination of force of articulation in FAS cannot be restricted to one single parameter. The diversity in the perception of listeners can only be explained by including all aspects of force of articulation in the analysis. Therefore, the foreign accent is not assumed to be in the speaker, but in the listener. Moreover, Di Dio, Schulz, and Gurd (2006) mention that FAS speakers' acquired accents do not contain 100% of the features of the new accent.

Of course, listeners' perception and familiarity with other languages play an important role in perceiving a foreign accent. We assume that the foreign accent in FAS is interpreted on the basis of the stereotypical segmental and prosodic characteristics that relate to the phonetics and phonology of specific languages. For example, a Dutch FAS speaker showed increased force of articulation in the production of voiceless plosives like /t/, leading to an aspirated production. Therefore, some listeners perceived his accent as German. German shows in general more force of articulation in the production of /t/ compared to the Dutch realisation, irrespective of registers and styles of speaking. Of course, you can shout or whisper in both languages, but, for example, the voice-onset time and the occlusion time of plosives are relatively longer in the German system than in the Dutch (e.g., Jansen, 2004). On the other hand, some listeners perceived the same accent as French. Gilbers et al. (2013) showed that this might be due to differences in vowel reduction and syllable duration in the cognitively stored ideal patterns of Dutch and French. Force of articulation leads to lack of vowel reduction and fewer differences in syllable duration, characteristics of both FAS speech and French.

Regarding these examples, it is expected that the direction in perception of a FAS accent will go from a language characterised by relatively more lenition processes into languages with relatively more fortition characteristics in their phonetic and phonological system and not the other way around. Our hypothesis is falsifiable on the basis of the data of former and new FAS speakers, which means we expect listeners to only hear accents in FAS speakers from languages that are characterised by a larger amount of force of articulation than the mother speech of the FAS speaker. This assumption predicts that people may hear, for example, a German, Spanish or Arabic accent in a Dutch FAS speaker, but not a Dutch accent in, for example, a Spanish or German FAS speaker. The purpose of this article is to put the proposed hypotheses in Gilbers et al. (2013) and van der Scheer et al. (2014) to the test.

Towards a force of articulation scale of languages

Before putting our hypothesis to the test, some remarks have to be made on the division of languages based on the amount of force of articulation. Because the listener may focus on one specific fortition cue, it is not always possible to indicate one dialect or language as higher in this force of articulation hierarchy of languages than another. Catford (1977, p. 203) indeed claims, "The terms tense/lax, strong/weak, fortis/lenis, and so on, should never be loosely and carelessly used without precise phonetic specification". English may seem to be lower in the hierarchy considering the strength of force of articulation than, for example, Dutch because all vowels in unstressed syllables are reduced to schwa. On the other hand, English initial /t/ in stressed syllables is aspirated, whereas it is not in this position in Dutch. In other words, with respect to voice-onset time, English may seem to be higher posited with respect to the strength of force of articulation than Dutch. Therefore, it is not possible to determine the position in the hierarchy of strongly related languages or dialects. It merely depends on which characteristics of FAS speech a listener focuses on.

Nevertheless, we will propose a coarse-grained division of languages and language families with respect to force of articulation based on the stress systems, the occurrence of lenition processes and segment realisations in these languages. The main division is between stress-timed languages and syllable-timed languages. Because of the lack of reduction in syllables, syllable-timed languages, with Spanish and French as prototypical examples, are regarded as stronger than stress-timed languages, such as English or Dutch. FAS speakers put more force in the realisation of all syllables, and therefore, their speech often lacks characteristics such as vowel reduction in unstressed syllables and shortening of unstressed syllables, which are typical for stress-timed languages. Within these two groups, the division is again based on lenition processes. With respect to stress-timed languages, Van Ommen, Hendriks, Gilbers, Van Heuven, and Gooskens (2013) show that Danish is characterised by more lenition processes than the strongly related language, Swedish. Therefore, we rather expect to find a Danish FAS speaker to speak with a Swedish accent than the other way around. In a similar way, Dutch is characterised by more lenition processes than German (Gilbers et al., 2013; Grijzenhout, 2000) and American English can be posited below Standard Southern British English (SSBE) based on, for example, lenition processes such as flapping in words like *city* and *letter*, which is characteristic for the former variant of English but absent in the latter. Scottish, on the other hand, can be characterised by more force than SSBE. Consider, for example, the word *girl* [gɛəl] or [gə:l] with lenition of /r/ in SSBE. This /r/ is realised in most Scottish variants of English: [gɛrəl], which almost sounds as a two-syllabic word. Notice that this typically resembles the segmentation of clusters that is seen in speakers with AoS that adapt to their articulation problems.

Furthermore, just like SSBE and Dutch, Scottish and most Irish dialects as well are stress-timed languages. However, whereas SSBE and Dutch are described as having weight-sensitive stress systems, Scottish and most Irish dialects are described as having a weight-insensitive stress system, like French and Spanish (Van der Hulst, 1999). In weight-sensitive systems, syllable structure plays a role in stress assignment. Typical for weight-sensitive systems is the duration difference between stressed and unstressed syllables, which is less noticeable in weight-insensitive systems. Therefore, we can posit Scottish in between SSBE and French in our force of articulation hierarchy of languages.

With respect to the group of syllable-timed languages, the staccato rhythm of syllables of approximately similar durations is intensified if syllable structure is less complicated as in most tone languages. Lin and Wang (2007) suggest that Mandarin Chinese has a syllable-timed rhythm, but being a tone language with simple syllable structures, it is posited higher in the hierarchy than syllable-timed languages such as Spanish or French.

In sum, proposing an iron-clad division of languages based on their force of articulation features is impossible. It depends on the specific cue in FAS speech the individual listener is focussing on. Yet, we expect that the direction of accent identification will go more often from stress-timed to syllable-timed languages, from weight-sensitive stress systems to weight-insensitive systems and within these language groups from non-aspirated to aspirated languages, from languages characterised by relatively more reduction and assimilation processes to languages with relatively less lenition. Sometimes, the changes in the amount of force of articulation in FAS can be very subtle: for example, intervocalic clear /l/ in Dutch where dark /l/ is expected. Table 1 shows the dominance relations between language types. Language types in the right boxes dominate the corresponding language types in the left boxes.

If languages from different families exhibit similar characteristics, we may expect perception in both directions. For example, Spanish might be perceived as Czech and

Table 1. Force of articulation dominance relations.

Stress-timed languages (e.g., English)	<Syllable-timed languages (e.g., French)
Non-aspirated languages (e.g., Dutch)	<Aspirated languages (e.g., German)
Weight-sensitive languages (e.g., SSBE)	<Weight-insensitive languages (e.g., Scottish)
Dynamic stress languages (e.g., German)	<Melodic stress languages (e.g., Spanish)
Dark-l languages/dialects (e.g., Norwegian)	<Clear-l languages/dialects (e.g., German)
Flapping languages/dialects (e.g., American English)	<Non-flapping languages/dialects (e.g., SSBE)
Relatively more lenition languages (e.g., Danish)	<Relatively less lenition languages (e.g., Swedish)
Non-tonal language (e.g., French)	<Tonal language (e.g., Mandarin Chinese)

the other way around, since both languages are syllable-timed, with melodic stress and weight-insensitive systems. Still, no matter which hierarchy we propose, it should be emphasised that the perceived accent depends on the specific fortition cue the listener focuses on.

As we have to deal with judgements of naive listeners, often in limited research conditions, we expect counterexamples. Reports on perceived accents are often anecdotal, and only in a small number of cases do listeners have to listen to fragments of speakers with FAS and other speakers with or without accents in a blind situation. These limited conditions, of course, increase the probability of finding counterexamples. Our investigation is also impeded by the fact that a majority of the cases in the literature is hardly supported by means of phonetic research, as will be indicated later. In these cases, it is impossible to detect cues of increased force of articulation. Still, one might expect that if force of articulation were not a major factor in the perception of foreign accents, the change of the perceived accents would be more or less bidirectional in our taxonomy in Table 1. If the number of perceived accents in the predicted direction approximates 50%, the hypothesis should definitely be rejected. Hundred percent seems impossible given the considerations put forward in this section, but if a clear majority of the cases indeed were to move in the predicted direction, we would consider the hypothesis to be supported by the data.

Method

In order to test our hypothesis about the accent changes in FAS cases that were published until now, we did a literature search with as search criterion "foreign accent syndrome" in PubMed. About 64 papers were identified on this topic. Next to this literature search, we added papers on FAS cases that were mentioned in one of these 64 papers, but were not part of the PubMed list. We ended up with 107 papers on FAS. By this, we do not assume to present all cases with FAS described before, but the sample is big enough to test our hypothesis.

The final sample we used for our analysis was obtained after adjusting the following criteria:

– We only considered cases that were described in English. Some cases of FAS are described in French, German, Spanish or Chinese and we will only address these cases in a general discussion.
– We only considered cases of FAS with a neurogenic origin. This means that we excluded psychogenic cases and developmental FAS. We will, however, again address these cases in a more general discussion later.

After applying these two criteria, we were left with 70 unique cases of neurogenic FAS. These 70 cases are presented in Table 2. All papers in which these cases were described were analysed by the first two authors of the current paper separately, on the basis of the aspects mentioned in Table 2. In case there was no agreement on the data, all authors discussed and reanalysed the papers. The aspects that were considered were age and sex of the FAS speaker, the aetiology of the neurological deficit that lead to FAS and its localisation, the presence and type of language and articulatory disorders and

Table 2. Overview of 70 unique cases of neurogenic FAS and their characteristics.

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
1	Monrad–Krohn (1947)[a]	30, F	Shrapnel wound in Broca's area (left frontal trauma)	Agrammatism, paraphasias	Impaired	Norwegian < German
2	Whitty (1964)	27, F	Intracerebral haemorrhage from a small angioma in the territory of the left middle cerebral artery	Normal	Impaired	English < German
3	Whitaker (1982)	30, F	Left hemisphere stroke	Mild agrammatism	Impaired	American < Spanish
4	Schiff, Alexander, Naeser, and Galaburda (1983)	58, M	Infarction in lower half of the left precentralrolandic gyrus	Mild aphasia	Impaired	Portugese/English < Chinese
5	Graff–Radford, Cooper, Colsher, and Damasio (1986)	56, M	Damage to the left premotor region and white matter anterior to the head of the left caudate nucleus	Aphasia; rare paraphasias	Impaired	American English < Scandinavian
6	Blumstein, Alexander, Ryalls, Katz, and Dworetzky (1987)	62, F	Left hemisphere stroke in the subcortical white matter of the pre-rolandic and postrolandic gyri at the level of the body of the lateral ventricle.	Mild agrammatism; mild semantic paraphasias	Impaired	American English < Eastern European, perhaps Slavic, French, Dutch, or Scandinavian
7	Gurd, Bessel, Bladon, and Bamford (1988)	41, F	Small isolated left basal ganglia infarction	Normal	Mild motor difficulties, slow and laborious speech	English < French
8	Ardila et al. (1988)	26, M	Left embolic stroke Broca's area	Slight agrammatism	Impaired	Spanish < English
9	Moen (1990, 2006)	61, F	Left sided stroke	Normal	Prosodically deviant and deviant articulation of consonants and vowels	Norwegian < English
10	Berthier et al. (1991)	70, M	Infarction in the middle portion of the left precentral gyrus	Normal	Impaired	Spanish < Slavic
11	Berthier et al. (1991)	58, M	Right frontoparietal infarction	Normal	Impaired, slow effortful speech	Spanish < Slavic
12	Berthier et al. (1991)	47, F	Haemorrhagic infarction left dorsolateral frontal region	Impaired grammar	Impaired, slow	Spanish < "foreign accent" (perhaps Hungarian)
13	Berthier et al. (1991)	34, F	Small infarction of the posterior-superior aspects of the left middle frontal gyrus	Limited verbal output	Impaired	Spanish < Slavic

(*Continued*)

Table2. (Continued).

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
14	Seliger, Abrams, and Horton (1992)	65, F	Deep left hemisphere stroke; subcortical infarction left	Normal	Mild dysarthria	American English < Irish
15	Ingram, McCormack, and Kennedy (1992)	56, F	Hematoma in lentiform nucleus	Rare paraphasias	Impaired; apraxia of speech	Australian English < Asian, Swedish and German
16	Takayama, Sugishita, Kido, Ogawa, and Akiguchi (1993)	44, F	Infarction in the middle fifth of the posterior lateral aspect of the left precentral gyrus	Normal		Japanese < Korean
17	Boatman, Gordon, Stone, and Anderson (1994)	52, M	Infarction left superior temporal gyrus extending to the parietal lobe	Mild anomia		American English < Norwegian
18	Kurowski, Blumstein, and Alexander (1996)	45, M	MRI: unexplained infarction of unknown aetiology.	Mild Broca's aphasia	Mild dysarthria	American < British, Scottish, Irish and East-European
19	Moonis et al. (1996)	59, M	Minor head injury, caudate nucleus, frontal gyrus	Mild anomia	Mild articulation problems	American English < French
20	Roth, Fink, Cherney, and Hall (1997)	48, M	Left parietal haemorrhagic stroke	Broca's aphasia: Agrammatism, mild anomia	Impaired	English < Dutch (speaker was born in the Netherlands)
21	Carbary, Patterson, and Snyder (2000)	51, M	Subcortical; pre-existing infarction in convolutions 2 and 3 of the posterior left frontal lobe	Normal	Mildly impaired	American English < unspecified "foreign accent"
22	Dankovičová et al. (2001)	43, F	Extensive infarction of the right middle cerebral artery, complicating a subarachnoid haemorrhage	Normal		English < Scottish
23	Gurd, Coleman, Costello, and Marshall (2001)	47, F	Minor non-specific ischemic changes both frontal lobes, left inferior frontal corona radiate and left thalamus	Normal	Impaired	English < French
24	Coelho and Robb (2001)	51, F	No abnormalities at CT	Word finding problems	Impaired	American < French/Canadian
25	Hall, Anderson, Filley, Newcombe, and Hughes (2003)	53, F	Small infarction in body of corpus callosum	Mild fluent aphasia		American English < French

(*Continued*)

Table2. (Continued).

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
26	Avila, González, Parcet, and Belloch (2004)	51, F	Mild neck trauma: small infarction in the left corona radiata and an infarction on the right temporal lobe	Normal		Patients' L1 was Spanish, but she also had a good command of French, English and Catalan (L2). FAS affected Spanish dramatically, but no important changes were observed for French; no specific accent reported
27	Coughlan, Lawson, and O'Neill (2004)	39, F	Infarction in the area of the left internal capsule	Word finding problems	Dysarthria	English (Ireland) < French
28	Bakker, Apeldoorn, and Metz (2004)	52, F	MS, deep white matter lesions in the corpus callosum, left parietal lobe and left frontal lobe	Word finding problems, grammatical errors		Canadian English < Dutch
29	Lippert–Grüner et al. (2005)	35, F	Traumatic haemorrhage in the left temporal lobe	Anomia	Mildly impaired	German < English
30	Munson and Heilman (2005)	49, F	Embolic left-hemispheric cortical infarction; left frontal opercular area	Mild word finding difficulties	Some misarticulations	American English < German
31	Mariën et al. (2006)	53, F	Left frontoparietal stroke; cerebellum?	Normal	Articulatory deviations	English < French, Russian, German
32	Miller et al. (2006)	60, M	SAB: Aneurysm right anterior communicating artery	Repetition and word finding problems	Apraxic-ataxic speech disorder	English < Italian and East-European
33	Varley, Whiteside, Hammill, and Cooper (2006)	40,F	Infarction in the anterior portions of the left middle cerebral artery territory and haemorrhagic changes within the left putamen	Mild aphasic difficulties	Apraxia of speech	British < Swedish
34	Scott, Clegg, Rudge, and Burgess (2006)	54, F	Small left hemisphere lesion, in white matter underneath the precentral sulcus, dorsal and medial to the anterior insula	Normal	Apraxia of speech	Scottish < German, Polish, South-African
35	Laures–Gore, Henson, Weismer, and Rambow (2006)	64, M	Right posterior temporal parietal and older CVA left basal ganglia and left cerebellum	Normal	Mild apraxia of speech	American English < Chinese, Dutch, Canadian
36	Laures–Gore et al. (2006)	67, F	MRI: no lesions	No aphasia, but patient answers with sí instead of yes	Normal to mild apraxia of speech	American English < Spanish, Jamaican

(*Continued*)

Table2. (Continued).

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
37	Kwon and Kim (2006)	71, F	Infarction in the left temporal and parietal area	Wernicke's aphasia		Cholla-buk (Korean dialect) < Kangwon (Korean dialect)
38	Ryalls and Whiteside (2006)	57, F	Lacunar infarction in left internal capsule	Normal		American English < British, Australian English
39	Fridriksson et al. (2005)[b]	45, M	Left basal ganglia, left putamen	Normal		American English < French, Greek, British English
40	Mariën and Verhoeven (2007)	61,M	Haemorrhagic lesion in the left basal ganglia	Conduction-like aphasia	Apraxia of speech characteristics	Dutch < North African
41	Wendt, Bose, Sailer, Scheich, and Ackermann (2007)	35,F	Left hemisphere stroke: left middle cerebral artery	Mild Broca's aphasia		German < Russian
42	Katz, Garst, and Levitt (2008)[c]	46, F	Moderate ventriculomegaly and frontal lobe atrophy	Mild anomic aphasia	Mild apraxia of speech; dysarthric speech	American English < Swedish, Eastern European
43	Luzzi et al. (2008)	64, F	Mild hypoperfusion of the perisylvian speech area of the left hemisphere and mild left perisylvian atrophy	First signs PPA		Italian < Spanish
44	Hoffmann (2008)	63, F	Garcin syndrome; cranial trauma	Normal	Mild dysarthria	American English < French
45	Naidoo, Warriner, Oczkowski, Sévigny, and Humphreys (2008)[d]	50, F	A well-defined area of hypoattenuation involving the left internal capsule, left basal ganglia, and left frontal corona radiata	Word finding problems; semantic paraphasias	Apraxia of speech	Canadian English < Canadian East Coast accent, partly a reported change from her native Southern Ontario accent
46	Abel, Hebb, and Silbergeld (2009)	60,F	Left anterior parietal lobe breast carcinoma metastasis	Normal	Dysarthria	American English < Swedish
47	Chanson et al. (2009)	39, F	hypersignal on T2-weighted images in the left preolandic white matter; diagnosis: MS	normal		French < German
48	Cohen, Kurowski, Steven, Blumstein, and Pascual–Leone (2009)	58,F	Left frontoparietal infarction	Normal		English < unspecified accent
49	Teymouri, Raghibdoust, and Modarressi (2009)	53,F	Central focal infarction left hemisphere	Normal		Persian < unspecified accent

(*Continued*)

Table2. (Continued).

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
50	Verhoeven and Mariën (2010)	53, F	Corticio-subcortical lesion which involved the inferior frontal gyrus, the precentral gyrus, the anterior insular cortex, the postcentral gyrus and the supramarginal gyrus of the left hemisphere	Normal	Apraxia of speech	Dutch < French, German
51	Perkins, Ryalls, Carson, and Whiteside (2010)	48, F	Trauma: bilateral TBI	Agrammatism	Slow dysfluent speech	English < Eastern European
52	Dankovičová and Hunt (2011)	56, M	Posterior parietal atrophy superior to the occipital sulcus	Normal		English (Cockney) < Italian, Greek
53	Bhandari (2011)	55, M	Diffusion in the left parieto-occipital region and in the left middle frontal gyrus	Normal		American English (Texan) < "foreign" and Cockney accent
54	Akhlagi, Jahangiri, Azarpazhooh, Elyasi, & Ghale (2011)	40, M	Right temporo-occipital lesion	Normal		Farsi < Yazdi or Isfahani accent
55	Kuschmann, Lowit, Miller, and Mennen (2012)[e]	61, F	Left-hemispheric CVA	Normal	Slurred speech	British English < French, Italian, Eastern European, Jamaican
56	Kuschmann et al. (2012)	49, F	Left-hemispheric CVA	Mild aphasic symptoms	Mild apraxia of speech	Scottish English < Italian, South African
57	Kuschmann et al. (2012)	61, M	Brain stem infarction	Normal	Slurred speech	British English < Italian
58	Kuschmann et al. (2012)	54, M	Left-hemispheric CVA	Normal	Voice problems	British English < Italian
59	Roy et al. (2012)[f]	63, F	Ischemic stroke left fronto-parietal	Mild Broca's aphasia	Mild apraxia of speech	Quebec French < Germanic
60	Perera, Rao, and Veltman (2012)	53, F	Ischemic infarction in the left corona radiata and left basal ganglia	Normal		English < German
61	Tomasino et al. (2013)	50, F	A brain tumour affecting the left precentral gyrus, at the border between the primary motor and premotor cortex	Normal		Italian < unspecified
62	Tran and Mills (2013)	60, F	Left hemi-pons	Normal	Slurred speech	American English < Jamaican, Italian, English

(*Continued*)

Table2. (Continued).

case	References	Age, sex	Aetiology/location	Language	Articulation	Accent ("<" = perceived as)
63	Pyun et al. (2013)	37,F	Left basal ganglia haemorrhage	Mixed aphasia	Dysarthria and a moderate degree of buccofacial apraxia and apraxia of speech	Korean < English
64	Moreno–Torres et al. (2013)	44, F	Bilateral small infarction left deep frontal	Normal	Mild articulation struggling	Spanish/Catalan (bilingual) < Czech and French
65	Mariën et al. (2013)	71, M	Haemorrhagic lesion in the right cerebellar hemisphere extending into the third and fourth ventricle	Normal	Atactic dysarthria	Dutch < German
66	Verhoeven et al. (2013)[g]	24, F	Infarction left insular region	Agrammatism	Apraxia of speech	English/Dutch bilingual < English
67	Gilbers et al. (2013)[h]	59, M	Infarction left middle cerebral artery	Normal	Apraxia of speech cannot be ruled out; symptoms of dysarthria	Dutch < Arabic, Turkish, Surinam, French, German
68	Gilbers et al. (2013)	55, F	Brain contusion left frontal area with subarchnoidal bleeding at the lateral sulcus left	Improved language problems	Mild to moderate apraxia of speech	Dutch < German, Polish, Spanish, French
69	Liu, Qi, Liu, Liu, and Li (2015)	41, F	TBI left temporal	Unknown		Chinese? < Mandarin
70	Liu et al. (2015)	25, M	TBI left temporal	Unknown		Chinese? < Mandarin

[a]Also discussed by Ryalls and Reinvang (1985); Moen (1990, 1991, 1996).
[b]Also described by Perkins et al. (2010).
[c]Also described by Katz et al. (2012).
[d]Also described by Kanjee et al. (2010).
[e]Cases 55–58 were also described by Kuschman and Lowit (2012), Lowit and Kuschman (2012) and Kuschmann and Lowit (2015).
[f]Another (psychogenic) case described by these authors was first described by Poulin et al. (2007).
[g]Other described cases were presented in earlier studies of Mariën, Verhoeven and co-authors.
[h]This case was also described by van der Scheer et al. (2014).

the native language or accent and the perceived accent of the FAS speaker. Only papers were included that provided this information and at least some description of the subject's accent, in order to discuss the accent when it could be seen as a counter-example to our hypothesis. We want to emphasise that we only discuss the counter-examples in this respect. Of course, it would be possible to describe the segmental and prosodic problems described for the cases in which an accent was heard that would fit our hypothesis. Nevertheless, there are only very few papers that give a full description of all these aspects, and still, even if we would find aspects that would not relate to force of articulation, the listeners still decided that they heard an accent in which more fortition was expressed.

Results

Most cases in Table 2 show changes from stress – to syllable-timed languages (e.g., #3), from weight-sensitive stress systems to weight-insensitive systems (e.g., #22), from non-aspirated to aspirated languages (e.g., #65) and from languages characterised by relatively more reduction and assimilation processes to languages with relatively less lenition (e.g., #38). Sometimes the change is very subtle. For example, in case 16, Japanese is perceived as Korean. These languages are phonologically rather similar, but Korean is a heavily aspirated language, whereas plosives in Japanese are hardly aspirated, a difference that is similar to the one between German and Dutch within the family of stress-timed languages (cf. #68). In some cases, we see changes within the same accent type group (e.g., #43). Nevertheless, most cases provide clear evidence for our hypothesis by going from, for example, English to French, American English to Spanish, Portuguese to Chinese, English to Scottish, Dutch to Turkish, etc. The perceived accent in some cases is described very broadly, for example, Slavic or East-European, without mentioning a specific language or dialect (#10, #11, #13, #51). Berthier, Ruiz, Massone, Starkstein, and Leiguarda (1991), for example, mention perceived Slavic accents in Buenos Aires Spanish. Nevertheless, in general, the descriptions of these cases fit our hypothesis of increased force of articulation, that is, slower speech, more pauses and a tendency to isosyllabicity.

In two cases, the native language was not specified (case #69 and #70). In six cases, (#12, #21, #26, #48, #49 and #61) the change of accent was described as a change to a generic accent, a foreign accent or just an unspecified accent change within the same language. If we abstract from these cases, we are left with 58 cases that can be used to test our hypothesis.

From the 58 cases left, 46 cases showed a change of accent in the expected direction, which is a change to an accent of a language in which more force articulation is expressed, as described in Table 1, and six cases remained within the same group of accent types. For some cases, the perception of several accents was mentioned. In these cases, we found that although several accents were mentioned, all the accent changes were in the same direction, that is, accents of languages in which more or comparable force of articulation is expressed. For example, in case #15, Swedish, Asian and German were mentioned as accents perceived in an Australian English speaker, and all three mentioned accents would be expected according to our hypothesis.

In sum, this means that nearly 90% of the cases do not contradict our hypothesis (52 out of 58 cases; 89.7%). The remaining six cases deserve special attention. Ardila, Rosselli, and Ardila (1988) present a Columbian Spanish-speaking patient who speaks with an English accent after his stroke (#8). This seems to be a counterexample to our hypothesis. However, the phonetic description of the speech shows clear aspects of fortition as well: lowering, fronting and backing of vowels (i.e., hyper-articulation), omission of unstressed vowels and stressing of vowels in diphthongs were seen in this patient. Moen (1990, 2006) describes the case of a Norwegian subject who speaks with an English accent after a stroke (#9). This patient's speech also reflects aspects of fortition and is characterised by a staccato rhythm, which in general gives the impression of a syllable-timed language, and a rise in pitch and intensity on word-initial syllables, aside from aspects of lenition as well. Lippert-Grüner, Weinert, Greisbach, and Wedekind (2005) describe a German patient who ends up with an English accent due to a traumatic brain injury (#29). Although it is tempting to conclude that also for this third case an increased force of articulation is described, as she exhibits strong lowering and lengthened short vowels, we do not see enough description of aspects of fortition to decide on this. Notice that this patient is also not a typical FAS patient. She suffered from a trauma and computed tomography and functional Magnetic Resonance Imaging revealed temporal lobe damage. She definitely cannot be seen as a speaker with an underlying AoS, leading to her FAS. After brain damage, she was mute, except for the expression of some English words. Moreover, the articulatory jaw movements of this patient were strongly limited the jaw being almost immobile. These two aspects could definitely also have influenced the perception of an English accent. The same considerations apply more or less for case #47, where the patient's accent changed from French into German (Chanson et al., 2009). This subject is also not a typical FAS patient as she suffered from multiple sclerosis, although this is also seen in case #28. Unfortunately, there is no phonetic description of her speech to investigate why a German accent was perceived. Such a clear phonetic description is provided in case #59 in which a Germanic accent is perceived in a Quebecois French speaker (Roy et al., 2012). The description shows an increased staccato rhythm explained by the authors as a tendency to homogenise syllable duration even within a syllable-timed language such as French. Furthermore, the speech was characterised by devoiced consonants: all characterisations of increased force of articulation. Yet, the perceived accent is described as Germanic. Finally, Pyun, Jang, Lim, Ha, and Cho (2013) describe an accent change from Korean to English (#63). The phonetic description mentions unusual rising pitch contours at the end of simple declaratives, prolonged intervals, slow rate, reduced fluency and initial consonant blocking. Furthermore, in this study, the participants had a restricted choice with respect to the indication of the perceived accent; they had to choose between Korean dialects, Japanese, Chinese and English for the perceived FAS accent.

In sum, we conclude that although in these six cases the perceived foreign accent clearly is an accent of a language in which less fortition is expressed, the reported phonetic descriptions, if available, suggest that they do not completely violate the hypothesis.

Other cases

As described in our method, we only provided cases that were described in English. In our literature search, we also found cases described in other languages. Among these are the first reports of FAS by Marie (1907) and Pick (1919). Marie described a Parisian French speaker who ended up with an Alsatian accent after stroke, and Pick mentioned a Czech soldier who had a Polish accent after stroke. Although both authors do not provide phonetic details about the accent itself, both hearing an Alsatian accent in a French speaker and hearing a Polish accent in a Czech speaker does not fit our hypothesis.

More recently, reports in Spanish and Chinese were found. Hwang, Lin, and Lin (2001) presented a case of a 40-year-old female Chinese Mandarin speaker who after a stroke ended up with an accent of an American English speaker trying to speak Mandarin. Gonzalez-Alvarez, Parcet-Ibars, Avila, and Geffner-Sclarsky (2003) described a case in Spanish of a 51-year-old Spanish-speaking woman who after an injury in the basal ganglia ended up with a French or other accent. Also a case in Spanish was published by Villaverde-González, Fernández-Villalba, Moreno-Escribano, Alías-Linares, and García-Santos (2002), describing a 38-year-old woman who acquired a French accent due to multiple sclerosis. These case descriptions, in general, show accent changes that support or, at least, do not go against our hypothesis, except for the cases described by Marie (1907), Pick (1919) and Hwang et al. (2001). For these cases, unfortunately, no more information is available as to why an Alsatian (Marie), Polish (Pick) or an American English (Hwang et al.) accent was perceived.

Other case descriptions that lack detail to be analysed in the same way as the cases described in Table 2 also in general support our hypothesis. Nielsen and McKeown (1961) describe two cases of American English speakers getting a Swedish accent after a cerebro vascular accident or an automobile accident, respectively. Critchley (1970) describes four cases of English speakers ending up with a Welsh accent after neurological damage, but in these cases, subjects were already speaking Welsh or had close contact to this language. Aronson (1990) mentions 13 cases from the Mayo Clinic, but provides an overview of these and 12 other cases without providing individual participant data, but he concludes that it is striking that a large number of accent changes involve a change into a Germanic accent. Edwards, Patel, and Pople (2005) provide six new cases of FAS. Two cases showed a change from English to a Welsh or Irish accent, respectively, but both subjects were rather familiar with these languages. One had a Scottish accent, but ended up with a Dutch/Swedish/Russian/German accent after stroke. There were three cases of British English speakers who ended up with a Dutch, French/German or American accent, respectively, the first two due to traumatic brain injury and the latter due to a stroke. Only the perceived American accent can be seen as a counterexample of our hypothesis, but unfortunately Edwards et al. do not provide any phonetic descriptions of the accent itself.

Cases with non-neurological origin

As said earlier, we excluded in our analyses cases of FAS without a neurogenic origin. As far as we know, 17 unique cases of FAS due to psychogenic or other non-neurological deficits (electrocution and jaw injury) are described until now and three cases of

Table 3. Overview of 20 unique cases of psychogenic or developmental FAS.

Case	References	Accent ("<" = perceived as)
1	Reeves and Norton (2001)	American English < British English
2	Verhoeven, Mariën, Engelborghs, D'Haenen, and De Deyn (2005)	Dutch < French
3	Van Borsel, Janssens, and Santens (2005)	Dutch < (mostly) Eastern Europe/French
4	Reeves, Burke, and Parker (2007)	American English < "Classical" Greek
5	Reeves et al. (2007)	American English < European
6	Reeves et al. (2007)	American English < British English
7	Poulin, Macoir, Paquet, Fossard, and Gagnon (2007)	Quebec French < Acadian French
8	Tsuruga, Kobayashi, Hirai, and Kato (2008)	Japanese < Chinese
9	Mariën, Verhoeven, Wackenier, Engelborghs, and De Deyn (2009)	Dutch < French
10	Mariën et al. (2009)	Dutch < French
11	Haley, Roth, Helm–Estabrooks, and Thiessen (2010)	American English < Spanish/French
12	Jones, Story, Collins, DeJoy, and Edwards (2011)	American English < Foreign accent
13	Lewis, Ball, and Kitten (2012)[a]	American English < Caribean accent
14	Crawford and Bavishi (2012)	American English < European accent
15	Tailby, Fankhauser, Josev, Saling, and Jackson (2013)	Australian English < French
16	Mendis, Haselden, and Costello (2013)	British English < Polish
17	DiLollo, Scherz, and Neimeyer (2014)	American English < Irish English
18	DiLollo et al. (2014)	American English < British English
19	Keulen et al. (2016)	French < Romance, Germanic and Slavic languages
20	Keulen et al. (2016)	Dutch < French; Mediterranean

[a]This case was also described by Kitten, Lewis, and Ball (2012).

developmental FAS. In Table 3, we provide these cases and we describe the perceived accent changes in them. The cases with developmental FAS are #9, #10 and #20 in Table 3.

In one case (#12), the accent change was not described or just described as foreign. In the other 19 cases, the accent change was, like in most of the neurogenic cases, into a language in which more fortition is expressed (mostly German or French). This is the case for the psychogenic cases, but also for the three developmental cases.

One case we would like to add to this overview is a case described by Ryalls and Miller (2015). In their book on FAS, many anecdotes are presented from people who suffer from FAS as well as anecdotes from FAS patients' relatives. In one case, a mother described the accent change of her daughter going from a German to a Dutch accent during several episodes. However, although neuroimaging took place, there was no evidence of a neurological background of this FAS. As there is also no evidence for a psychogenic background and as there is no description of the speech problems of this subject, the case was not added to the overview, but it would be an example against the hypothesis.

Discussion

In this article, we provided an overview of the cases of neurogenic FAS that, as far as we know, have been published in English to date. We came up with an overarching explanation for the accent change in the cases that were described. It is notable that accent changes mostly go in the same direction. Accent changes, especially to American English, are, with few exceptions, not reported, where if accent changes were random more of these cases would have been described. In contrast, we mostly see changes from accents of languages expressing more lenition in their speech to accents with more fortition. We assume that the increase of force of articulation seen in FAS speakers is due to their underlying deficit. In line with many other authors describing cases of FAS (Fridriksson et al., 2005; Kanjee et al., 2010; Mariën & Verhoeven, 2007; Miller et al., 2006; Moen, 2000; Roy et al., 2012; Whiteside & Varley, 1998), we assume that FAS is often due to an underlying AoS. Speakers with AoS adapting to this underlying disorder will speak slowly and use strategies like segmentation and scanned speech. By speaking slowly and using such strategies, speakers will put much more force of articulation into their speech, leading to, for example, a lack of assimilation and stress on every single syllable; however, speaking with more force of articulation may lead to different accents. FAS is not only seen in subjects with AoS though. As Miller et al. (2006) already pointed out, we should not state that FAS is a symptom of AoS, as it is also seen in speakers with dysarthria or even in speakers with no evident speech disorder. These speakers are often described as speaking slowly or as using scanned speech. In all these cases, the presumed accent therefore is not assumed to be in the speech of the FAS speaker, but it is the interpreted accent of the listener. Listeners focus on stereotypical segmental or prosodic aspects of speech, on the basis of which decide on a specific accent.

The fact that listeners focus on different aspects of speech also means that it is not possible to come up with a hierarchy of possible accent changes. In the introduction, we explained that, for example, English and Dutch have some aspects that would put English higher in such a hierarchy, whereas other aspects would lead to a higher position for Dutch. Nevertheless, we identified some aspects of force of articulation and provided expectations with respect to the change of accents. According to us, accents were expected to change from stress-timed to syllable-timed languages, from weight-sensitive stress systems to weight-insensitive systems, and within these language groups from languages characterised by, for example, relatively more reduction and assimilation processes to languages with relatively less lenition, or from languages with relatively short voice onset times in plosives to languages with relatively longer ones.

We tested our hypothesis with the FAS cases that have been described until now. We restricted ourselves to the cases of neurogenic FAS described in English and to which enough details were provided in order to be able to judge the accent change. From the 58 cases that fitted with these criteria, 89.7% showed a change of accent in the expected direction. From these cases, six were changes within the same type of accents. Only six accent changes did not directly support our hypothesis. The reported phonetic descriptions of the cases, if available, nevertheless suggest that they do not seem to completely violate our hypothesis.

We also made an overview of the other neurogenic cases that were published until now, including the ones published in other languages. Most accent changes in these cases are described in the expected direction as well, although we have to admit that there are also some cases, among which the first described cases of FAS by Marie (1907) and Pick (1919), that do not show the expected direction. Unfortunately, detailed descriptions lack for these counterexamples. Therefore, we are not able to discuss why unexpected accents were reported in these cases.

A change of accent in the expected direction also seems to hold for the developmental and psychogenic cases of FAS. With respect to the latter observation, it is not possible to assume that an adaptation to an underlying impairment leads to an increase of force of articulation. However, it is remarkable that also in these cases the same distribution of accent changes is seen. We speculate that in the psychogenic cases, the slow speech of the speakers (due to their psychogenic deficit or due to the medication they use) may lead to comparable symptoms as seen in speakers with neurogenic FAS. Of course, this speculation deserves more detailed future research, especially to the underlying impairment in these cases.

We tested our hypothesis on the cases of FAS described so far. However, our hypothesis is still falsifiable with future cases of (neurogenic) FAS. Table 1 may be used for this purpose. To be able to interpret and compare cases, it is advised that the foreign accent is clearly described, especially with respect to the segmental and prosodic aspects of the accent, that a group of naive, objective listeners is asked to judge the accent without forced choices and favourably by providing them not only a sample of the foreign accent, but also other speech samples with, for example, second-language learners, as Verhoeven et al. (2013) have done and a clear description of the language and articulatory deficits from which a speaker suffers; the ideal situation would be access to the FAS speaker's speech sample, to give all scholars interested in FAS the opportunity to hear the perceived accent themselves.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Abel, T. J., Hebb, A. O., & Silbergeld, D. (2009). Cortical stimulation mapping in a patient with foreign accent syndrome: Case report. *Clinical Neurology and Neurosurgery*, *111*, 97–101. doi:10.1016/j.clineuro.2008.07.014

Akhlaghi, A., Jahangiri, N., Azarpazhooh, M. R., Elyasi, M., & Ghale, M. (2011). Foreign accent syndrome: Neurolinguistic description of a new case. In *Proceedings of 2011 International Conference on language, literature and linguistics*. Dubai: UAE.

Ardila, A., Rosselli, M., & Ardila, O. (1988). Foreign accent: An aphasic epiphenomenon? *Aphasiology*, *2*, 493–499. doi:10.1080/02687038808248955

Aronson, A. E. (1990). *Clinical voice disorders: An interdisciplinary approach*. New York: Thieme.

Avila, C., González, J., Parcet, M., & Belloch, V. (2004). Selective alteration of native, but not second language articulation in a patient with foreign accent syndrome. *Clinical Neuroscience and Neuropathology*, *15*, 2267–2270.

Bakker, J. I., Apeldoorn, S., & Metz, L. M. (2004). Foreign accent syndrome in a patient with multiple sclerosis. *The Canadian Journal of Neurological Sciences*, *31*, 271–272. doi:10.1017/S0317167100053956

Berthier, M. L., Ruiz, A., Massone, M. I., Starkstein, S. E., & Leiguarda, R. C. (1991). Foreign accent syndrome: Behavioural and anatomical findings in recovered and non-recovered patients. *Aphasiology*, *5*, 129–147. doi:10.1080/02687039108249478

Bhandari, H. S. (2011). Transient foreign accent syndrome. *BMJ Case Reports*, *2011*, doi:10.1136/bcr.07.2011.4466.

Blumstein, S. E., Alexander, M. P., Ryalls, J. H., Katz, W., & Dworetzky, B. (1987). On the nature of the foreign accent syndrome: A case study. *Brain and Language*, *31*, 215–244. doi:10.1016/0093-934X(87)90071-X

Boatman, D., Gordon, B., Stone, M., & Anderson, S. (1994). Studies of articulatory timing in normal and foreign accent syndrome speech. *Brain and Language*, *47*, 549–552.

Carbary, T., Patterson, J., & Snyder, P. (2000). Foreign accent syndrome following a catastrophic second injury: MRI correlates, linguistic and voice pattern analyses. *Brain and Cognition*, *43*, 78–85.

Catford, J. (1977). *Fundamental problems in phonetics*. Bloomington: Indiana University Press.

Chanson, J. B., Kremer, S., Blanc, F., Marescaux, C., Namer, I. J., & De Seze, J. (2009). Foreign accent syndrome as a first sign of multiple sclerosis. *Multiple Sclerosis*, 1–3. doi: 10.1177/1352458509106611

Coelho, C. A., & Robb, M. P. (2001). Acoustic analysis of foreign accent syndrome: An examination of three explanatory models. *Journal of Medical Speech-Language Pathology*, *9*, 227–242.

Cohen, D. A., Kurowski, K., Steven, M. S., Blumstein, S. E., & Pascual-Leone, A. (2009). Paradoxical facilitation: The resolution of foreign accent syndrome after cerebellar stroke. *Neurology*, *73*, 566–567. doi:10.1212/WNL.0b013e3181b2a4d8

Coughlan, T., Lawson, S., & O'Neill, D. (2004). French without tears? Foreign accent syndrome. *Journal of the Royal Society of Medicine*, *97*, 242–243. doi:10.1258/jrsm.97.5.242

Crawford, K. M., & Bavishi, S. (2012). Poster 36 development of foreign accent syndrome following mild traumatic brain injury: A case report. *PM&R*, *4*, S202. doi:10.1016/j.pmrj.2012.09.666

Critchley, M. (1970). *Aphasiology and other aspects of language*. London: Edward Arnold.

Dankovičová, J., Gurd, J. M., Marshall, J. C., McMahon, M. K. C., Stuart-Smith, J., Coleman, J. S., & Slater, A. (2001). Aspects of non-native pronunciation in a case of altered accent following stroke (foreign accent syndrome). *Clinical Linguistics and Phonetics*, *15*, 195–218. doi:10.1080/02699200010004656

Dankovičová, J., & Hunt, C. (2011). Perception of foreign accent syndrome speech and its relation to segmental characteristics. *Clinical Linguistics and Phonetics*, *25*, 85–120. doi:10.3109/02699206.2010.513027

Di Dio, C., Schulz, J., & Gurd, J. M. (2006). Foreign accent syndrome: In the ear of the beholder? *Aphasiology*, *20*, 951–962. doi:10.1080/02687030600739356

DiLollo, A., Scherz, J., & Neimeyer, R. A. (2014). Psychosocial implications of foreign accent syndrome: Two case examples. *Journal of Constructivist Psychology*, *27*, 14–30. doi:10.1080/10720537.2013.819305

Edwards, R. J., Patel, N. K., & Pople, I. K. (2005). Foreign accent following brain injury: Syndrome or epiphenomenon? *European Neurology*, *53*, 87–91. doi:10.1159/000085503

Feiken, J., & Jonkers, R. (2012). *Diagnostisch Instrument voor Apraxie van de Spraak (DIAS)* [Diagnostic instrument for apraxia of speech]. Houten: Bohn, Strafleu en Van Loghum.

Fridriksson, J., Ryalls, J., Rorden, C., Morgan, P. S., George, M. S., & Baylis, G. C. (2005). Brain damage and cortical compensation in foreign accent syndrome. *Neurocase*, *11*, 319–324. doi:10.1080/13554790591006302

Gilbers, D., Jonkers, R., van der Scheer, F., & Feiken, J. (2013). On the force of articulation in the foreign accent syndrome. In C. Gooskens & R. Van Bezooijen (Eds.), *Phonetics in Europe* (pp. 11–33). Hamburg: Peter Lang.

Gonzalez-Alvarez, J., Parcet-Ibars, M. A., Avila, C., & Geffner-Sclarsky, D. (2003). [A rare neurologically originated speech disorder: Foreign accent syndrome]. *Revista de Neurologia*, *36*, 227–234.

Graff-Radford, N. R., Cooper, W. E., Colsher, P. L., & Damasio, A. R. (1986). An unlearned foreign "accent" in a patient with aphasia. *Brain and Language*, *28*, 86–94. doi:10.1016/0093-934X(86)90093-3

Grijzenhout, J. (2000, June). *Constraint demotion and constraint transfer*. Paper presented at the GGS-Meeting, Potsdam.

Gurd, J. M., Bessel, N. J., Bladon, R., & Bamford, J. M. (1988). A case of foreign accent syndrome, with follow-up clinical, neuropsychological and phonetic descriptions. *Neuropsychologia*, *26*, 237–251. doi:10.1016/0028-3932(88)90077-2

Gurd, J. M., Coleman, J. S., Costello, A., & Marshall, J. C. (2001). Organic or functional? A new case of foreign accent syndrome. *Cortex*, *37*, 715–718. doi:10.1016/S0010-9452(08)70622-1

Haley, K. L., Roth, H. L., Helm-Estabrooks, N., & Thiessen, A. (2010). Foreign accent syndrome due to conversion disorder: Phonetic analyses and clinical course. *Journal of Neurolinguistics*, *23*, 28–43. doi:10.1016/j.jneuroling.2009.08.001

Hall, D. A., Anderson, C. A., Filley, C. M., Newcombe, J., & Hughes, R. L. (2003). A French accent after corpus callosum infarct. *Neurology*, *60*, 1551. doi:10.1212/01.WNL.0000058762.73309.39

Hoffmann, M. (2008). Foreign accent syndrome mimicked by Garcin syndrome with spontaneous resolution. *Behavioural Neurology*, *19*, 195–197. doi:10.1155/2008/498652

Hwang, C. S., Lin, M. H., & Lin, S. K. (2001). Pure foreign accent syndrome: A case report. *Acta Neurologica Taiwanica*, *10*, 196–201.

Ingram, J. C. L., McCormack, P. F., & Kennedy, M. (1992). Phonetic analysis of a case of foreign accent syndrome. *Journal of Phonetics*, *20*, 457–474.

Jansen, W. (2004). *Laryngeal contrast and phonetic voicing: A laboratory phonology approach to English, Hungarian, and Dutch* (PhD dissertation). University of Groningen, Groningen.

Jones, H. N., Story, T. J., Collins, T. A., DeJoy, D., & Edwards, C. L. (2011). Multidisciplinary assessment and diagnosis of conversion disorder in a patient with foreign accent syndrome. *Behavioural Neurology*, *24*, 245–255. doi:10.1155/2011/786560

Jonkers, R., Terband, H., & Maassen, B. A. M. (2014). Diagnosis and therapy in adult acquired dysarthria and apraxia of speech in Dutch. In N. Miller & A. Lowit (Eds.), *Motor speech disorders. A cross-language perspective* (pp. 156–167). Bristol: Multilingual Matters.

Kanjee, R., Watter, S., Sévigny, A., & Humphreys, K. (2010). A case of foreign accent syndrome: Acoustic analyses and an empirical test of accent perception. *Journal of Neurolinguistics*, *23*, 580–598. doi:10.1016/j.jneuroling.2010.05.003

Katz, W. F., Garst, D. M., Briggs, R. W., Cheshkov, S., Ringe, W., Gopinath, K. S., … Allen, G. (2012). Neural bases of the foreign accent syndrome: A functional magnetic resonance imaging case study. *Neurocase*, *18*, 199–211. doi:10.1080/13554794.2011.588173

Katz, W. F., Garst, D. M., & Levitt, J. (2008). The role of prosody in a case of foreign accent syndrome (FAS). *Clinical Linguistics & Phonetics*, *22*, 537–566. doi:10.1080/02699200802106284

Keulen, S., Mariën, P., Wackenier, P., Jonkers, R., Bastiaanse, R., & Verhoeven, J. (2016). Developmental foreign accent syndrome: Report of a new case. *Frontiers in Human Neuroscience*, *10*, 1–9. doi:10.3389/fnhum.2016.00065

Keulen, S., Verhoeven, J., Bastiaanse, R., Mariën, P., Jonkers, R., Mavroudakis, N., & Paquier, P. (2016). Perceptual accent rating and attribution in psychogenic FAS: Some further evidence challenging Whitaker's operational definition. *Frontiers in Human Neuroscience*, *10*, 1–14. doi:10.3389/fnhum.2016.00062

Kitten, S., Lewis, S., & Ball, L. J. (2012). P-186-Mania-induced foreign accent syndrome: A case study. *European Psychiatry*, *27*, 1. doi:10.1016/S0924-9338(12)74353-5

Kurowski, K. M., Blumstein, S. E., & Alexander, M. (1996). The foreign accent syndrome: A reconsideration. *Brain and Language*, *54*, 1–25. doi:10.1006/brln.1996.0059

Kuschmann, A., & Lowit, A. (2012). Phonological and phonetic marking of information status in foreign accent syndrome. *International Journal of Language & Communication Disorders*, *47*, 738–749. doi:10.1111/j.1460-6984.2012.00184.x

Kuschmann, A., & Lowit, A. (2015). The role of speaking styles in assessing intonation in foreign accent syndrome. *International Journal of Speech-Language Pathology*, *17*, 489–499. doi:10.3109/17549507.2015.1016106

Kuschmann, A., Lowit, A., Miller, N., & Mennen, I. (2012). Intonation in neurogenic foreign accent syndrome. *Journal of Communication Disorders*, *45*, 1–11. doi:10.1016/j.jcomdis.2011.10.002

Kwon, M., & Kim, J. S. (2006). Change of dialect after stroke: A variant of foreign accent syndrome. *European Neurology*, *56*, 249–252. doi:10.1159/000096674

Laures-Gore, J., Henson, J. C., Weismer, G., & Rambow, M. (2006). Two cases of foreign accent syndrome: An acoustic phonetic description. *Clinical Linguistics & Phonetics*, *20*, 781–790. doi:10.1080/02699200500391105

Lewis, S., Ball, L. J., & Kitten, S. (2012). Acoustic and perceptual correlates of foreign accent syndrome with manic etiology: A case study. *Communication Disorders Quarterly*, *34*, 242-247. doi:10.1177/1525740112466913

Lin, H., & Wang, Q. (2007). Mandarin rhythm: An acoustic study. *Journal of Chinese Linguistics and Computing*, *17*, 127–140.

Lippert-Grüner, M., Weinert, U., Greisbach, T., & Wedekind, C. (2005). Foreign accent syndrome following traumatic brain injury – a case report. *Brain Injury*, *19*, 955–958. doi:10.1080/02699050500109506

Liu, H. E., Qi, P., Liu, Y. L., Liu, H. X., & Li, G. (2015). Foreign accent syndrome: Two case reports and literature review. *European Review for Medical and Pharmacological Sciences*, *19*, 81–85.

Lowit, A., & Kuschmann, A. (2012). Characterizing intonation deficit in motor speech disorders: An autosegmental–metrical analysis of spontaneous speech in hypokinetic dysarthria, ataxic dysarthria, and foreign accent syndrome. *Journal of Speech, Language, and Hearing Research*, *55*, 1472–1484. doi:10.1044/1092-4388(2012/11-0263)

Luzzi, S., Viticchi, G., Piccirilli, M., Fabi, K., Pesallaccia, M., Bartolini, M., … Snowden, J. S. (2008). Foreign accent syndrome as the initial sign of primary progressive aphasia. *Journal of Neurology, Neurosurgery & Psychiatry*, *79*, 79–81. doi:10.1136/jnnp.2006.113365

Marie, P. (1907). Présentation de malades atteints d'anarthrie par lésion de l'hémisphère gauche du cerveau. *Bulletins et Mémoires Société Médicale des Hôpitaux de Paris*, *1*, 158–160.

Mariën, P., & Verhoeven, J. (2007). Cerebellar involvement in motor speech planning: Some further evidence from foreign accent syndrome. *Folia Phoniatrica et Logopaedica*, *59*, 210–217. doi:10.1159/000102933

Mariën, P., Verhoeven, J., Engelborghs, S., Rooker, S., Pickut, B., & De Deyn, P. (2006). A role for the cerebellum in motor speech planning. Evidence from foreign accent syndrome. *Clinical Neurology & Neurosurgery*, *108*, 518–522. doi:10.1016/j.clineuro.2005.06.006

Mariën, P., Verhoeven, J., Wackenier, P., Engelborghs, S., & De Deyn, P. P. (2009). Foreign accent syndrome as a developmental motor speech disorder. *Cortex*, *45*, 870–878. doi:10.1016/j.cortex.2008.10.010

Mariën, P., Verslegers, L., Moens, M., Dua, G., Herregods, P., & Verhoeven, J. (2013). Posterior fossa syndrome after cerebellar stroke. *The Cerebellum*, *12*, 686–691. doi:10.1007/s12311-013-0478-7

Mendis, D., Haselden, K., & Costello, D. (2013). Short case report: 'Speaking in tongues'—Foreign accent syndrome. *Logopedics Phoniatrics Vocology*, *38*, 79–81. doi:10.3109/14015439.2012.695392

Miller, N., Lowit, A., & O'Sullivan, H. (2006). What makes acquired foreign accent syndrome foreign? *Journal of Neurolinguistics*, *19*, 385–409. doi:10.1016/j.jneuroling.2006.03.005

Moen, I. (1990). A case of the `foreign accent syndrome'. *Clinical Linguistics & Phonetics*, *4*, 295–302. doi:10.3109/02699209008985492

Moen, I. (1991). Functional lateralisation of pitch accents and intonation in Norwegian: Monrad-Krohn's study of an aphasic patient with altered "melody of speech". *Brain and Language*, *41*, 538–554. doi:10.1016/0093-934X(91)90173-X

Moen, I. (2000). Foreign accent syndrome: A review of contemporary explanations. *Aphasiology*, *14*, 5–15. doi:10.1080/026870300401577

Moen, I. (2006). Analysis of a case of the foreign accent syndrome in terms of the framework of gestural phonology. *Journal of Neurolinguistics*, *19*, 410–423. doi:10.1016/j.jneuroling.2006.03.001

Moen, I. (1996). Monrad-Krohn's FAS case. In C. Code, C.-W. Wallesh, Y. Joanette, & A. Roch Lecours (Eds.), *Classic cases in neuropsychology* (pp. 159–171). London: Psychology Press, L. Erlbaum.

Monrad-Krohn, G. H. (1947). Dysprosody or altered "melody of language". *Brain*, *70*, 405–415. doi:10.1093/brain/70.4.405

Moonis, M., Swearer, J. M., Blumstein, S. E., Kurowski, K. M., Licho, L., Kramer, P., … Drachman, D. A. (1996). Foreign accent syndrome following a closed head injury. Perfusion deficit on SPECT with normal MRI. *Neurology*, *43*, 381.

Moreno-Torres, I., Berthier, M. L., Del, M., Cid, M., Green, C., Gutiérrez, A., … Carnero-Pardo, C. (2013). Foreign accent syndrome: A multimodal evaluation in the search of neuroscience-driven treatments. *Neuropsychologia*, *51*, 520–537. doi:10.1016/j.neuropsychologia.2012.11.010

Munson, P. D., & Heilman, B. (2005). Foreign accent syndrome: Anatomic, pathophysiologic and psychosocial considerations. *South Dakota Journal of Medicine*, *58*, 187–189.

Naidoo, R., Warriner, E. M., Oczkowski, W. J., Sévigny, A., & Humphreys, K. R. (2008). A case of foreign accent syndrome resulting in regional dialect. *The Canadian Journal of Neurological Sciences*, *35*, 360–365. doi:10.1017/S0317167100008970

Nielsen, J. M., & McKeown, M. (1961). Dysprosody. Report of two cases. *Bulletin of the Los Angeles Neurological Society*, *26*, 157–159.

Perera, P., Rao, N., & Veltman, L. (2012). Poster 552 foreign accent syndrome in stroke patient: A case report. *Pm&R*, *4*, S379. doi:10.1016/j.pmrj.2012.09.1151

Perkins, R., Ryalls, J., Carson, C., & Whiteside, J. (2010). Acoustic analyses of two recovered cases of foreign accent syndrome. *Aphasiology*, *24*, 1132–1154. doi:10.1080/02687030903022211

Pick, A. (1919). Über Änderungen des Sprachcharakters als Begleiterscheinung aphasischer Störungen. *Zeitschrift für die Gesamte Neurologie und Psychiatrie*, *45*, 230–241. doi:10.1007/BF02871733

Poulin, S., Macoir, J., Paquet, N., Fossard, M., & Gagnon, L. (2007). Psychogenic or neurogenic origin of agrammatism and foreign accent syndrome in a bipolar patient: A case report. *Annals of General Psychiatry*, *6*, 1. doi:10.1186/1744-859X-6-1

Pyun, S., Jang, S., Lim, S., Ha, J., & Cho, H. (2013). Neural substrate in a case of foreign accent syndrome following basal ganglia hemorrhage. *Journal of Neurolinguistics*, *26*, 479–489. doi:10.1016/j.jneuroling.2013.03.001

Reeves, R. R., Burke, R. S., & Parker, J. D. (2007). Characteristics of psychotic patients with foreign accent syndrome. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *19*, 70–76. doi:10.1176/jnp.2007.19.1.70

Reeves, R. R., & Norton, J. W. (2001). Foreign accent-like syndrome during psychotic exacerbations. *Cognitive and Behavioral Neurology*, *14*, 135–138.

Roth, E. J., Fink, K., Cherney, L. R., & Hall, K. D. (1997). Reversion to a previously learned foreign accent after stroke. *Archives of Physical Medicine and Rehabilitation*, *78*, 550–552. doi:10.1016/S0003-9993(97)90176-3

Roy, J. P., Macoir, J., Martel-Sauvageau, V., & Boudreault, C. A. (2012). Two French-speaking cases of foreign accent syndrome: An acoustic-phonetic analysis. *Clinical Linguistics and Phonetics*, *26*, 934–945. doi:10.3109/02699206.2012.723237

Ryalls, J., & Miller, N. (2015). *The stories people have to tell*. Hove: Psychology Press.

Ryalls, J., & Reinvang, I. (1985). Some further notes on Monrad-Krohn's case study of foreign accent syndrome. *Folia Phoniatrica et Logopaedica*, *37*, 160–162. doi:10.1159/000265795

Ryalls, J., & Whiteside, J. (2006). An atypical case of foreign accent syndrome. *Clinical Linguistics and Phonetics 20*, 157–162. doi:10.1080/02699200400026900

Schiff, H. B., Alexander, M. P., Naeser, M. A., & Galaburda, A. M. (1983). Aphemia: Clinical-anatomic correlations. *Archives of Neurology*, *40*, 720. doi:10.1001/archneur.1983.04050110038005

Scott, S., Clegg, F., Rudge, P., & Burgess, P. (2006). Foreign accent syndrome, speech rhythm and the functional neuroanatomy of speech production. *Journal of Neurolinguistics*, *19*, 370–384. doi:10.1016/j.jneuroling.2006.03.008

Seliger, G. M., Abrams, G. M., & Horton, A. (1992). Irish broke after stroke. *Stroke*, *23*, 1655–1656. doi:10.1161/01.STR.23.11.1655

Tailby, C., Fankhauser, J., Josev, E. K., Saling, M. M., & Jackson, G. D. (2013). Clinical foreign accent syndrome evolving into a multiplicity of accents. *Journal of Neurolinguistics*, *26*, 348–362. doi:10.1016/j.jneuroling.2012.11.002

Takayama, Y., Sugishita, M., Kido, T., Ogawa, M., & Akiguchi, I. (1993). A case of foreign accent syndrome without aphasia caused by a lesion of the left precentral gyrus. *Neurology*, *43*, 1361–1363. doi:10.1212/WNL.43.7.1361

Teymouri, R., Raghibdoust, S., & Modarressi, G. (2009). Foreign accent syndrome-case report. *Iranian Rehabilitation Journal*, *7*, 50–56.

Tomasino, B., Marin, D., Maieron, M., Ius, T., Budai, R., Fabbro, F., & Skrap, M. (2013). Foreign accent syndrome: A multimodal mapping study. *Cortex*, *49*, 18–39. doi:10.1016/j.cortex.2011.10.007

Tran, A. X., & Mills, A. D. (2013). A case of foreign accent syndrome. *Journal of Emergency Medicine 45*, 26–29. doi:10.1016/j.jemermed.2012.11.015

Tsuruga, K., Kobayashi, T., Hirai, N., & Kato, S. (2008). [Foreign accent syndrome in a case of dissociative (conversion) disorder]. *Seishin shinkeigaku zasshi= Psychiatria et neurologia Japonica*, *110*, 79–87.

van Borsel, J., Janssens, L., & Santens, P. (2005). Foreign accent syndrome: An organic disorder? *Journal of Communication Disorders*, *38*, 421–429. doi:10.1016/j.jcomdis.2005.03.004

van der Hulst, H. G. (1999). Word accent. In H. G. van der Hulst (ed.), *Word prosodic systems in the languages of Europe* (pp. 3–116). Berlin & New York: Mouton de Gruyter.

van der Scheer, F., Jonkers, R., & Gilbers, D. G. (2014). Foreign accent syndrome and force of articulation. *Aphasiology 28*, 471–489. doi:10.1080/02687038.2013.866210

van Ommen, S., Hendriks, P., Gilbers, D., van Heuven, V., & Gooskens, C. (2013). Is diachronic lenition a factor in the asymmetry in intelligibility between Danish and Swedish? *Lingua*, *137*, 193–213. doi:10.1016/j.lingua.2013.09.009

Varley, R., Whiteside, S., Hammill, C., & Cooper, K. (2006). Phases in speech encoding and foreign accent syndrome. *Journal of Neurolinguistics*, *19*, 356–369. doi:10.1016/j.jneuroling.2006.03.002

Verhoeven, J., De Pauw, G., Pettinato, M., Hirson, A., Van Borsel, J., & Mariën, P. (2013). Accent attribution in speakers with foreign accent syndrome. *Journal of Communication Disorders*, *46*, 156–168. doi:10.1016/j.jcomdis.2013.02.001

Verhoeven, J., & Mariën, P. (2010). Neurogenic foreign accent syndrome: Articulatory setting, segments and prosody in a Dutch speaker. *Journal of Neurolinguistics*, *23*, 599–614. doi:10.1016/j.jneuroling.2010.05.004

Verhoeven, J., Mariën, P., Engelborghs, S., D'Haenen, H., & De Deyn, P. (2005). A foreign speech accent in a case of conversion disorder. *Behavioural Neurology*, *16*, 225–232. doi:10.1155/2005/989602

Villaverde-González, R., Fernández-Villalba, E., Moreno-Escribano, A., Alías-Linares, E., & García-Santos, J. M. (2002). [Foreign language syndrome as a first sign of multiple sclerosis]. *Revista de Neurologia*, *36*, 1035–1039.

Wendt, B., Bose, I., Sailer, M., Scheich, H., & Ackermann, H. (2007). Speech rhythm of a woman with foreign accent syndrome (FAS). In Trouvain, J. & W.J. Barry (Eds.) *Proceedings from ICPhS 2007: The sixteenth international congress of phonetic sciences*. Saarbrucken, Germany.

Whitaker, H. A. (1982). Levels of impairment in disorders of speech. In R. N. Malatesha & L. C. Hartlage (Eds.), *Neuropsychology and cognition* (Vol. 1, Nato Advanced Study Institutes Series D, No. 9, pp. 168–207). The Hague: Nijhoff.

Whiteside, S. P., & Varley, R. A. (1998). A reconceptualisation of apraxia of speech: A synthesis of evidence. *Cortex*, *34*, 221–231. doi:10.1016/S0010-9452(08)70749-4

Whitty, C. W. M. (1964). Cortical dysarthria and dysprosody of speech. *Journal of Neurology, Neurosurgery and Psychiatry*, *27*, 507–510. doi:10.1136/jnnp.27.6.507